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DESCRIPTION OF THE MALE OF *TYLENCHORHYNCHUS TOBARI* SAUER & ANNELLS, 1981 AND OBSERVATIONS ON THE MORPHOLOGY AND HOST RANGE OF THE FEMALE IN ARID SOUTH AUSTRALIA

by J. M. Nobbs*

Summary

Nobbs, J. M. (1991) Description of the male of *Tylenchorhynchus tobari* Sauer & Annells, 1981 and observations of the morphology and host range of the female in arid South Australia. *Trans. R. Soc. S. Aust.* 115(2), 83–88, 31 May, 1991.

In a survey of the arid region of South Australia, over 300 sites were found to have *Tylenchorhynchus tobari* Sauer & Annells, 1981. Previously undescribed males of *T. tobari* were identified from only nine sites and are described here. From field observations, plant species of the family Chenopodiaceae were most likely to have *T. tobari* present. This was tested by culturing the nematode on different host plants in the glass-house. It was found that environment affected the morphometrics of different field populations of *T. tobari* but not general morphology.

Key Words: *Tylenchorhynchus tobari*, arid South Australia, males, host plant, Nematoda

Introduction

The arid region of South Australia consists of diverse vegetation and landforms. There is little information on the occurrence and diversity of the plant parasitic nematode fauna within this region. During a survey of the area (Nobbs 1989), one of the most widely distributed plant parasitic nematodes was *Tylenchorhynchus tobari* Sauer & Annells, 1981. The wide distribution of the nematode over a range of environments offered the opportunity to examine the effect of environmental variation on the nematode. This paper examines the effects of environment on female morphometrics and possible hosts among the diverse plant species sampled. Males are described for the first time.

Methods

Extraction of nematodes

Soil was collected from undisturbed native vegetation which occurred close to the main tracks that run throughout the arid region. Over 300 sites were sampled and the sampled plant species noted. The nematodes were extracted from 50 ml of each soil sample using a modified Baermann funnel (Schindler 1961).

Morphology and measurements of Tylenchorhynchus tobari

To examine the effect of different environments on variation in morphometrics, ten sites were selected from different areas. From each site, ten females were processed through an alcohol series and mounted in glycerol by the wax method (Hooper 1986). Measurements (in mm) of body length, body width, oesophageal length, position of the vulva, tail length, tail width and stylet length were then made under high magnification and the de Man ratios (a, b, c and c′) were calculated. Analysis of variance (ANOVA) was used to determine if there were significant differences in measurements between the ten different populations.

Occurrence in the field and in pots

To determine the most likely host plant of *T. tobari* the number of sites on which a particular plant species occurred was sampled and compared with the actual (or observed) number of sites where that particular plant was sampled and found to have *T. tobari* present. The number of sites where a particular host plant was sampled was used as a percentage of the total sites sampled (expected sites). Using Chi-square analysis (Bailey 1976) the observed number of sites was then compared with the expected number of sites to determine most likely host species. Due to the diversity of the vegetation sites, grouping of the host species was necessary (e.g. Chenopods = plant species of the family Chenopodiaceae).

This information allowed investigation of possible hosts of *T. tobari*. Seeds of native and introduced species including *Atriplex spongiosa, A. lindleyi, Chenopodium quinoa, Lycopersicum esculentum* and *Hordeum vulgare* (cv. Clipper) were surface sterilised (3 min. in 1% bleach), pregerminated in a Petri-dish, planted into a 1:4 parts soil to sand mix and inoculated with 50 female *T. tobari*. After two and a half months, the shoots were removed and the roots and soil washed through a set of sieves (500 μm, 250 μm and 40 μm aperture).

* CABI Institute of Parasitology, 395A Hatfield Rd, St Albans, England, AL4 OXU.

The sediment on the 250 μm and 40 μm sieves was collected and placed in a modified Baerman's funnel for three days. The nematode extract was then counted for *T. tobari*. There were three replicates from each plant species.

Results

Morphometrics of male and female Tylenchorhynchus tobari *in the arid region of South Australia*

Males of *T. tobari* were identified from nine different sites within the arid region of South Australia (Fig. 1) and mean values ± standard deviations of morphometric measurements for all sites (n = 20 specimens) are presented below. In addition, the same data for a single site (n = 9) near Kingoonya (grid reference 299 180, map KINGOONYA SH53-11 (1 : 250,000) edition 1, series R502, Royal Australian Survey Corps) are provided. The original measurements of Sauer & Annells (1981) for females as well as the grand means of the 10 sites selected are also presented.

Females: original description (Sauer & Annells 1981 (n = 19): Body length = 690 μm (610 - 770); a = 36 (30 - 38); b = 5.0 (4.5 - 6.2); c = 12 (11 - 14); c' = 3.8 (3.1 - 4.4); V = 54 (51 - 54); stylet = 17 - 19 μm. Survey 1983 - 1985 (n = 100) : Body length = 721 ± 62 μm (595 - 900); a = 30.3 ± 3.1 (25.4 - 42.5); b = 5.2 ± 0.5 (4.0 - 7.6); c = 14.0 ± 3.0 (10.6 - 25.1); c' = 3.0 - 0.8 (1.7 - 4.3); V = 54.4 ± 2.1 (49 - 59); stylet = 17.3 ± 1.4 μm (14 - 21).

Males (Fig. 2) (n = 20) : Body length = 672 ± 18 μm (586 - 752); a = 30.9 ± 1.5 (25.8 - 38.7); b = 5.2 ± 0.2 (4.0 - 5.6); c = 10.8 ± 0.6 (8.5 - 13.2); c' = 3.8 ± 0.2 (2.9 - 4.7); spicule length = 25.5 ± 1.3 μm (19 - 30); gubernaculum = 11.3 ± 2.1 μm (8 - 17); stylet length = 16.7 ± 0.7 μm (14 - 20).

Site near Kingoonya (n = 9) : Body length = 676 ± 26 μm (619 - 727); a = 29.9 ± 0.9 (25.8 - 32.3); b = 5.2 ± 0.2 (4.3 - 5.8); c = 11.7 ± 0.4 (10.4 - 13.2); c' 3.7 ± 0.2 (2.9 - 4.3); spicule length = 25.1 ± 1.1 μm (22 - 28); gubernaculum = 11.2 ± 1.3 μm (8 - 17); stylet length = 17.0 ± 0.7 μm (14 - 18).

Description of the male

(Fig. 2) Similar to female in anterior region. Lip region offset, 6 - 8 annules, stylet of medium development, with backwardly sloping stylet knobs. Testis single, not reflexed. Tail enveloped by a large, simple, crenate bursa. Spicules distally flanged, terminus narrow, gubernaculum well developed, generally rod-like, protruding. Phasmid easily seen, just anterior to mid-point of tail.

Occurrence in the field and in pots

Chi-square analysis showed that *T. tobari* was found in significantly more sites than expected only where plant species of the family Chenopodiaceae were the most common species (Table 1). Therefore, the most likely preferred host plant is a member of the family Chenopodiaceae. With the pot tests there was some multiplication of *T. tobari* with all the five plant species tested, but *Antriplex spongiosa* had the greatest multiplication rate (Table 2).

Analysis of populations

Although only a small number of females per population were measured, significant differences in morphometrics were observed. Of the characters measured only position of the vulva (V), de Man ratio's a, b, and c' were not significantly different between populations (Table 3). Body length, body width, tail length, tail width, oesophageal length, stylet length and de Man c ratio were all significantly different between naturally occurring populations.

In one population (9), almost all of the observed values were greater than the standard deviation of the grand mean. Few of the other populations had any or more than one value beyond the range of plus or minus the standard deviation. There were no obvious differences in general morphology between specimens collected from the ten sites, so the differences in measurements between the populations are most likely due to environmental effects such as recent rainfall, host species present and soil type rather than species differences.

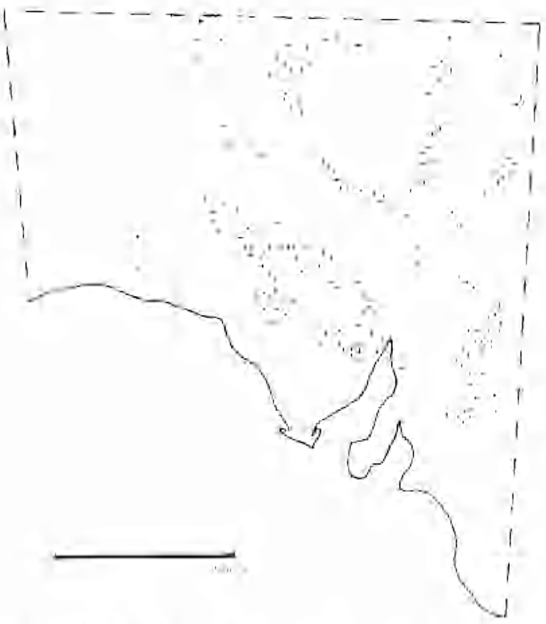

Fig. 1. The distribution of *Tylenchorhynchus tobari* Sauer & Annells, 1981 within the arid region of South Australia. Closed circles are sites from which *T. tobari* was identified; open circles are sites at which males were identified. Sites 1-10 were sites from which ten females were measured.

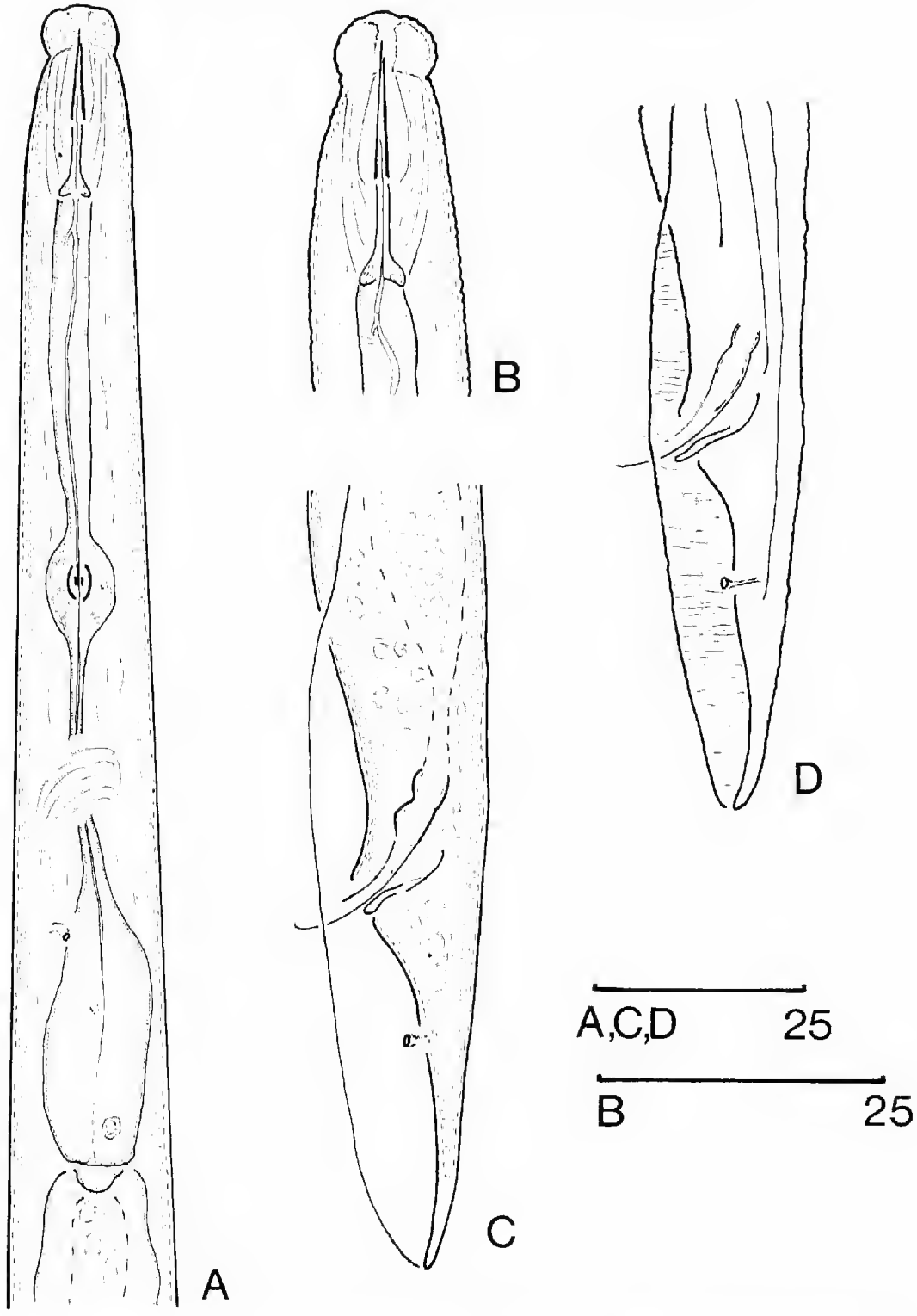

Fig. 2. Morphology of the male of *Tylenchorhynchus tobari* Sauer & Annells, 1981. A = oesophageal region; B = head region; C = shape of tail (internal); D = shape of tail (external). Scale in microns (μm).

TABLE 1. *The host plant/groups and number of sites where* Tylenchorhynchus tobari *Sauer & Annells, 1981 was collected.*

Species/groups	Number of Sites Observed	Expected	Chi-square value	% Total Sites Sampled in Survey 1983–85
Chenopods	140	108.5	9.14 ##	33.5
Ephemerals	14	14.6	0.02	4.5
Eucalyptus spp.	27	36.6	2.52	11.3
Acacia spp.	71	76.8	0.44	23.7
Grasses	9	15.6	2.79	4.8
Shrubs: *(Eremophila, Dodonea, Cassia* sp.)	16	25.6	3.60	7.9
Trees: *(Myoporum, Pittosporum, Callitris* sp.)	24	18.8	1.44	5.8
Salicornia spp.	8	7.8	0.01	2.4
Reeds	0	2.9	2.90	0.9
Zygocloea paradoxa	15	16.8	0.19	5.2
Total	324	324.0	23.05 **	100.0

** = significantly different, df = 9, P = 0.01, Chi-square analysis.
= significantly different, df = 1, P = 0.01, Chi-square analysis.
The null hypothesis that there is no difference between the expected numbers of sites from which certain plant species/groups were sampled and the presence of *Tylenchorhynchus tobari* in the soil sample is rejected.
The % total sites indicate the number of samples from which soil was sampled in the period 1983 to 1985 and were used to calculate expected number of sites with *T. tobari.*

TABLE 2. *Final number and multiplication rate of* Tylenchorhynchus tobari *from an initial inoculation of fifty females and sampled after two and a half months. (mean ± standard deviation).*

Plant species	Mean number	Multiplication rate
Atriplex lindleyi	212.7 ±55.9	4.2 ±1.12
A. spongiosa	1238.3 ±224.6	24.8 ±4.50
Hordeum vulgare (var. Clipper)	56.0 ±17.4	1.1 ±0.35
Lycopersicum esculentum	209.7 ±29.7	4.2 ±0.96
Chenopodium quinoa	499.0 ±64.7	10.0 ±1.29

TABLE 3. *Measurements of different populations of* Tylenchorhynchus tobari *from the arid region of South Australia.*

Population	Body length	Body width	Tail length	Tail width	Length of oesophagus	Length stylet	c ratio
1	699.3	23.6	52.2	17.6	130.0⁻	17.0	13.9
2	699.5	23.6	56.1	17.6	135.7	17.2	12.7
3	716.9	23.3	49.4	16.9	145.2	16.8	14.8
4	725.6	23.4	47.4⁻	17.3	146.2⁻	18.7⁺	15.4
5	701.0	24.0	55.5	18.8⁻	133.9	18.0	13.5
6	724.2	24.1	54.5	18.6	137.0	16.2⁻	13.7
7 #	734.0	23.8	58.2⁺	18.3	133.3	17.4	12.7
8 #	701.6	23.8	56.8	18.7	130.6	16.2	12.6
9	793.9⁺	27.2⁺	49.6	18.3	152.1⁺	18.3⁺	16.6⁺
10	713.4	22.8	49.9	16.8⁻	140.7	17.6	14.3
Grand Mean + *S.D.*	720.7 *61.8*	23.9 *2.4*	52.9 *8.4*	17.8 *1.8*	138.5 *11.8*	17.3 *1.4*	14.0 *3.0*
F-value	2.40 **	2.79 **	2.28 **	2.06 **	3.57 **	4.41 ***	2.12 **

Significant at P = 0.01% level indicated by **; significant at P = 0.001% level indicated by ***; d.f. = 9, 86. Grand mean is calculated from all 100 nematodes measured and includes the standard deviation *(S.D.)* in italics. # = populations where males were identified.

⁻ indicates value less than lowest value of the standard deviation of the grand mean. ⁺ indicates value greater than highest value of the standard deviation of the grand mean.

Measurements are in microns (μm).

Discussion

Males of *Tylenchorhynchus tobari* were found in only a small number of sites and in low numbers indicating that *T. tobari* may reproduce parthenogenetically. Populations of *T. tobari* from different natural habitats differ significantly in certain morphometric characters. However, the description of a new species is not necessary as the populations are still identifiable morphologically as *T. tobari*. Many workers (Davide 1980; Fortuner 1984a; Fortuner & Queneherve 1980; Kline 1976; Roggen & Asselberg 1971; Townsend & Blakith 1975; Saha & Khan 1988; Singh *et al.* 1985) have looked at the influence of host on morphometrics of different species of nematode. They found that many characters were highly variable between populations and that ratios were of little overall value (except V) in determining species. Fortuner (1984b) suggested that observations of several populations were important in estimating the mean and range of measurements. When identifying species, morphology should always be used with priority over morphometrics as differences in measurements can often be attributed to environmental effects.

T. tobari is a migratory ectoparasite and so has a wide host range. In the field the most common plants sampled with *T. tobari* present were of the family Chenopodiaceae. In pot cultures *Atriplex spongiosa* allowed the greatest multiplication. In using a host plant that allows rapid multiplication of *T. tobari*, the host/parasite relationship can be investigated.

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